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Grid System Mapping of *Ferula tadshikorum* Pimenov (Apiaceae) Distributed in Uzbekistan

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Abstract

This article presents information on the distribution of *Ferula tadshikorum* Pimenov species in the botanical—geographical region of Uzbekistan, based on data collected from available resources, including international sites, and databases, completed papers and directly conducted field studies. At the same time, under the circumstance that the natural area is directly getting smaller, the necessity and relevance of the thesis work on the evaluation of species' natural reserves and the evaluation of the modern situations are demonstrated through examples. The Surkhandarya region is considered to have the largest number of plant species in Uzbekistan, and it is also distinguished by the variety of species. According to the location of the botanical-geographical regions of Uzbekistan, the territory of the Surkhandarya region is divided into five botanical-geographical regions (BGR). The 5 × 5 km^2 grid system map includes 882 cells. Surkhan-Sherabod (BGR), Baisun (BGR), Sangardak-Topalang (BGR), Babatag (BGR), and Kuhitang (BGR) corresponded to these. Simultaneously, the 5 × 5 km^2 grid system map of Uzbekistan's flora in the Surkhandarya region revealed the presence of *F. tadshikorum* in 109 indices. On the territory of the region, the botanic-geographic region mainly includes the *F. tadshikorum*, Babatag (BGR), Baisun (BGR), and Kohitang (BGR) indices. The natural resources of *F. tadshikorum* in these areas were also analyzed.

Keywords

Botanical-Geographic Region, Territory, Species, Genus, Area, Herbarium, Flora, TASH, Site, Database, Decree, Decision

1. Introduction

Naturally growing medicinal plants also have a limited supply of raw materials, and their protection, study of their bioecological properties, proper use of raw materials, and development of scientifically based methods of reproduction are

considered urgent problems. A number of decisions and decrees were adopted by the government in order to rationally use the natural resources of medicinal plants in the flora of Uzbekistan, to organize their plantations, to process raw materials, and to increase exports.

In the Republic of Uzbekistan, for the last few years, a number of specific, goal-oriented research projects have been conducted to determine the distribution areas of medicinal plants and their natural reserves. It is possible to contribute to the production of promising medicinal preparations in local conditions if the natural reserves of *F. tadshikorum* species, which have medicinal properties, are used effectively and rationally. Cultivation, using the opportunities to create plantations, causes the preservation of the natural resources of the plant. This necessitates the need to determine the areas where *F. tadshikorum* is spread, to evaluate the plant stock in them, and to make recommendations for its production in the pharmaceutical industry on this basis.

It is known that this species grows in the ecological spaces of the hilly and lower mountain regions of South-western Hisar, Panjoldi, Hisar-Darvaz districts at heights of 700 - 1800 meters above sea level with oleaginous, red sandy soil, and gray soft gray soil.

In the information provided in Flora Uzbekistan (2023), 47 species of the genus are listed in the flora of Uzbekistan [1], nine of which are included in the Red Book of the Republic of Uzbekistan [2]. Species of the genus distributed in the Surkhandarya region are used by the people for various purposes. For example, from the roots of *F. foetida* (Bunge) Regel, *F. sumbul* (Kauffm.) Hook. stem and root, *F. tenuisecta* Korovin leaf, *F. tadshikorum* Pimenov root, and *F. foetidissima* Regel & Schmalh, from the root, *F. kuhistanica* Korovin is collected to extract sap and other substances.

At the same time, it is used by the population in other spheres of life (medicine, food) [3]. 17 species of the *Ferula* L. group are distributed in the flora of this region, of which *F. tadshikorum*, *F. tuberifera*, *F. sumbul*, and *F. fedtschenkoana* species are included in the Red Book of the Republic of Uzbekistan [2]. Species of this genus Ferula are known to contain essential oils or resinous substances, coumarins, flavonoids, terpenoids, glycosides, and lactones. Most of these compounds are biologically active and can be used as medicines and food supplements.

2. Research Methods

The article contains information on the distribution of the species *Ferula tadshikorum* Pimenov, local flora, records of conducted floristic and geobotanical studies, scientific literature and dissertations, international sites (https://www.plantarium.ru, https://plant.depo.msu.ru), and the herbarium was analyzed based on the materials stored in TASH, MW, LE, AA, TAJ, FRU, MSB, P, VILR funds. Distribution of Uzbekistan in botanical-geographical regions was carried out according to the scheme developed by Tojibaev, *et al.* [4] Information

about the species is provided based on the sources cited by Pimenov M.G. [5] and Rakhmonov X.S [6].

3. Results

Ferula tadshikorum was included in science by the species *Ferula tadshikorum* Pimenov, first published in Bull. Main. Bot. Sada 94: 54 (1974) [5].

Information about this species can be found in Systematics, carpology, ecology and distribution of some species reflected in the work of Safina *et al* [5] [7].

***Ferula tadshikorum* Pimenov.** It belongs to the genus *Narthex* (Falcon.) Drude of the genus *Ferula* [4]. This plant was included in science as a species in 1974 by Pimenov [5] [7] on the basis of samples collected from the southern part of Tajikistan (Central Asia, southern Tajikistan, Sarsaryak village, Vakhsh river valley, Shar-Shar pass, in a maple tree from *Acer regelii* Pax. 1200 m above sea level. 5.06.1971, No.507, Pimenov M.G.) in 1971 [5]. From a systematic point of view, the species *Ferula foetidissima* Regel & Schmalh. is close to the species and differs by the size of the fruit, the width of the wings in the seed, and the size of the conducting channels [7].

Baisun botanical-geographic region. 524 genera and 1564 species belonging to 89 families were found in the flora of the region [8]. There are 13 species of *Ferula* L. in the flora of the region: *F. clematidifolia* Koso-Pol., *F. foetidissima* Regel et Schmalh., *F. gigantea* B. Fedtsch., *F. kelifi* Korovin, *F. kokanica* Regel and Schmalh., *F. kuhistanica* Korovin, *F. mollis* Korovin, *F. moschata* (H. Reinsch) Koso-Pol., *F. ovina* (Boiss.) Boiss., *F. samarkandica* Korovin, *F. tadshikorum* Pimenov, and *F. tuberifera* Korovin are listed [8].

Kugitang botanical-geographic region. Until now, there are no exact numbers about the flora of this region; there are only numbers about the flora of the Surkhan State Reserve within the region (77 families, 372 genera, 747 species), which do not provide information about the general flora of the region because the region occupies a much larger area. It is possible that more than 10 species of the *Ferula* L. group can be found in the flora of the botanical-geographic region, because in the Surkhan state reserve, 7 species of *Ferula gigantea* B. Fedtsch., *F. kuhistanica* Korovin, *F. nevskii* Korovin, *F. ovina* (Boiss.) Boiss., *F. schtschurowskiana* Regel, Schmalh., *F. tadshikorum* Pimenov, and *F. tuberifera* Korovin are found [9].

Pri Pandj district. This district includes only the Bobotog botanical-geographic region [4]. Among the specimens stored in herbarium funds, the number of specimens collected from the Bobotog region is the majority compared to other regions. In addition, Locus classicus has more species belonging to this region compared to other regions. Until now, no specific floristic studies have been carried out in this area; in recent years, research work on the flora of the area has been carried out [10]. In the region, about 10 species of *Ferula* L. genus *F. tadshikorum* Pimenov., *F. clematidifolia* Koso-Pol., *F. gigantea* B.Fedtsch., *F. kuhistanica* Korovin., *F. bucharica* (Lipsky) Koso-Pol., *F. foetidissima* Regel & Schmalh., *F. kelifi*

Korovin., *F. kokanica* Regel & Schmalh occur because there are different ecotopes in the area. The main part of the region is covered by oleaginous red sand slopes [11].

The grid system map of the natural flora of Uzbekistan was created on the basis of the WGS 1984 (World Geodetic System 1984) projection in ArcGIS version 10.6.1. The administrative map of the Republic of Uzbekistan and the botanical-geographical zoning scheme of the flora of Uzbekistan were taken into account when drawing up the map. The developed map consists of 19,240 squares, each with an area of 5 × 5 km^2, and each square is named with indices including the English alphabet and numbers. 882 of these cells correspond to South-West Hisar, Hisar-Darvaz, and Panjoldi districts (part of the Surkhandarya region) (**Figure 1**).

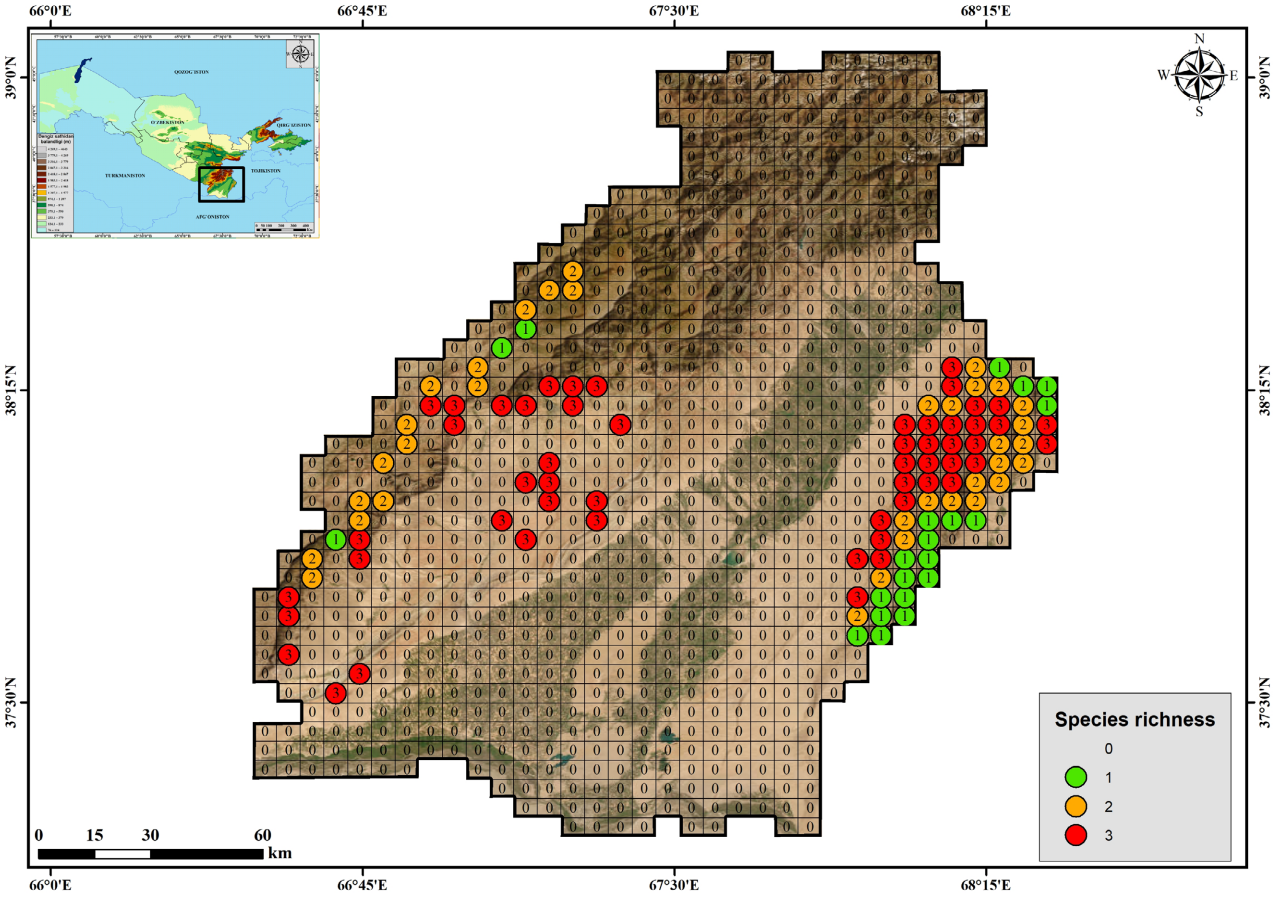

Figure 1. Location of *F. tadshikorum* in the flora of the Surkhandarya region on a grid system map.

Among the botanical-geographic districts, according to the number of indices, South-West Hisar district (646) is the leader, followed by Hisar-Darwaz (186) and Panj (178) districts (**Figure 2**).

In addition, the territory of the Surkhandarya region is divided into five botanical geographic regions (BGR). These are the following: Surkhan-Sherabod 312, Boysun 194, Sangardak-Topalang 191, Bobotog 181, Kuhitang 132 BGR 5 × 5 km^2 indices, but adding up the indices of each BGR makes a total of 1010 indices, but

there are crossings in 5 × 5 km^2 indices in the BGR range, the total number of crossings is 128 indices. [12] [13]. A number of studies are being carried out on the study of plants distributed naturally in our republic [14]-[19]. It was also about the medicinal plant that a lot of research was carried out [20] [21].

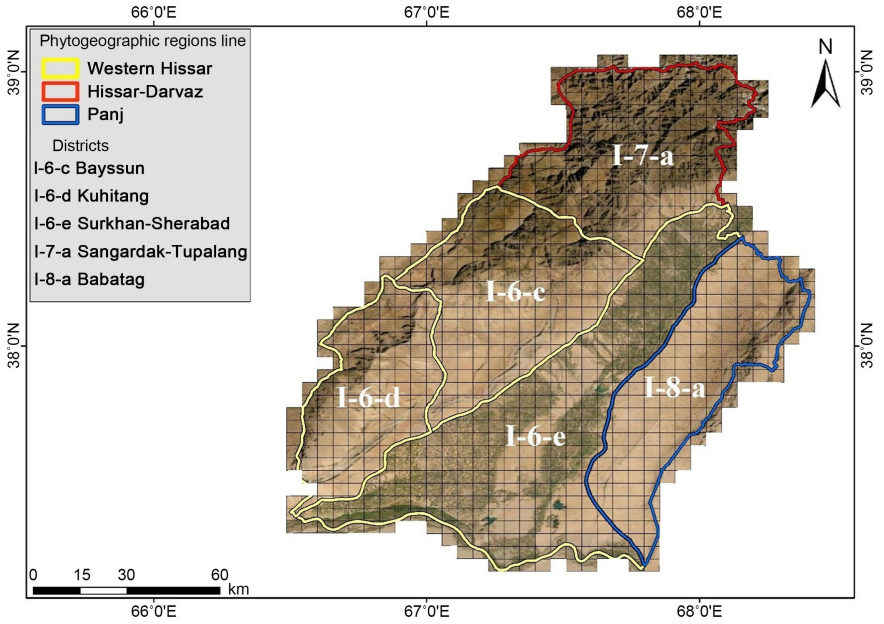

Figure 2. Geographic location of Surkhandaryo province and its phytogeographic subdivision.

Grid-system mapping makes it possible to consolidate scattered data sets into one system, visualize them using modern technologies, software packages (representation on maps, preparation of infographics), fast and high-quality data exchange, and most importantly, the universalization of floristic research. Based on this, the data collected within the framework of the state program of grid system mapping of the flora of South-Western Hisar, Hisar-Darvaz, and Panjoldi districts (part of the Surkhandarya region) is being carried out in digital format. This process makes it possible to get individual information on the section of indexes while transferring the use of the database formed on the basis of the selected parameters to a convenient form.

The data were linked to the indices by geographic coordinates to reflect the results of the research on grid system maps and to provide an individual approach to each of the indices. The distribution of *F. tadshikorum* in the territory of the Surkhandarya region mainly covers the Bobotog (BGR), Boysun (BGR), and Kohitang (BGR) indexes according to its botanical and geographical location (Figure 2).

At the same time, it was found that *F. tadshikorum* is found in 109 indices of the 5 × 5 km^2 grid system map of the flora of Uzbekistan in the Surkhandarya region (Figure 2). The natural resources of F. tadshikorum in these areas were also analyzed (Table 1).

Table 1. The occurrence of F. tadshikorum in 5 × 5 km grid cells in the Surkhandarya region in 109 indices.

№	Page Name	№	Page Name	№	Page Name	№	Page Name	№	Page Name
1	H188	23	O213	45	R215	67	U217	89	W218
2	I189	24	P188	46	S196	68	U218	90	X192
3	J186	25	P189	47	S197	69	V191	91	X194
4	K210	26	P196	48	S212	70	V193	92	X197
5	K211	27	P211	49	S213	71	V200	93	X198
6	L186	28	P212	50	S214	72	V212	94	X199
7	L210	29	P213	51	S215	73	V213	95	X214
8	L211	30	Q189	52	S216	74	V214	96	X215
9	L212	31	Q195	53	T190	75	V215	97	X216
10	M186	32	Q199	54	T197	76	V216	98	X217
11	M210	33	Q211	55	T212	77	V217	99	X218
12	M211	34	Q212	56	T213	78	V218	100	Y194
13	M212	35	Q213	57	T214	79	W192	101	Y214
14	N187	36	Q214	58	T215	80	W193	102	Y215
15	N211	37	Q215	59	T216	81	W195	103	Y216
16	N212	38	R189	60	T217	82	W196	104	Z195
17	N213	39	R190	61	U191	83	W198	105	AA196
18	O187	40	R197	62	U212	84	W213	106	AB196
19	O189	41	R199	63	U213	85	W214	107	AC197
20	O210	42	R212	64	U214	86	W215	108	AC198
21	O211	43	R213	65	U215	87	W216	109	AD198
22	O212	44	R214	66	U216	88	W217		

4. Discussion

The scope of such preliminary data allows for a complete mapping of the composition of the flora in the territory of the Surkhandarya region. For this, of course, grid system mapping is one of the best research methods. As a result of analyzing the distribution of the species across the botanical-geographical regions of Uzbekistan, the following conclusions were drawn.

It is known that this species grows in the ecological spaces of the hilly and lower mountain regions of south-western Hisar, Panjoldi, and Hisar-Darvaz districts at heights of 700 - 1800 meters above sea level. As a result of the annual increase of external influence on the species, individuals during the flowering period were almost not visible, which is explained by the decline of the gene pool of the species. Today, by establishing industrial plantations of the species, it is possible to reduce the external impact on natural populations. In this way, the gene pool of the

species is preserved, and positive results are achieved.

5. Conclusions

The problem of protecting the environment and flora is of great, vital importance for all mankind. Using natural resources, people negatively affect the natural landscapes that have been forming for centuries. The development of industry and agriculture, the widespread settlement of natural territories leads to a violation of the ecological balance, as a result of which the danger of impoverishment of the species composition of the flora and loss of the plant gene pool gradually increases.

Studying the biological characteristics of *Ferula L.* species in their ontogeny, organizing plantations from plants to get enough resin from them for export, and dealing with the problems of rational use of existing natural areas are considered urgent tasks. Accordingly, it is of scientific and practical importance to evaluate the modern status of *Ferula tadshikorum* senopopulations distributed in the Surkhandarya region based on critical views and clarify the information on their status in the Red Book of the Republic of Uzbekistan (2019). The conducted research and the available resources require a critical approach and new research to determine the taxonomic diversity, biogeography, ecology, and scientific issues of conservation of the F. tadshikorum species in the Surkhondarya basin, which is represented by a high percentage of endemic species. From this point of view, it is of great scientific and practical importance to determine the taxonomic structure through the in-depth analysis of available data and targeted field research to study the scientific basis of species protection and geographical distribution.

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Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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